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COOPERATIVE
BULK FERTILIZER BLENDING
IN THE UPPER MIDWEST

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By Theodore R. Eichers

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UNITED STATES DEPARTMENT OF AGRICULTURE ● FARMER COOPERATIVE SERVICE

FARMER COOPERATIVE SERVICE
U.S. DEPARTMENT OF AGRICULTURE
WASHINGTON D.C. 20250

Joseph G. Knapp, Administrator

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, financing, merchandising, product quality, costs, efficiency, and membership.

The Service publishes the results of such studies; confers and advises with officials of farmer cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

The Tennessee Valley Authority provided financial and advisory assistance in conducting this study.

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Summary

Thirteen fertilizer blending plants in Minnesota, Wisconsin, Iowa, and South Dakota operating in 1963 are the subject of this report. Two regional cooperatives operated the plants.

Plants had been in operation 2 to 5 years and were generally serving an area with a 25- to 50-mile radius.

Small grains, corn, and hay were crops on which blended fertilizers were most frequently used.

Buildings.--Bulk blending plants were neat, low-cost, frame structures. Building costs ranged from $10,000 to $50,000.

The plants had from six to eight ingredient storage bins, each with a capacity of about 100 tons.

Almost all plants were kept in excellent condition; however in many plants, wall construction on both outside walls and bins was not sufficiently rigid to hold the heavy materials, and bulging walls were quite common.

Equipment.--The plants had a minimum of equipment. Essential items were front-end loader, scale, mixer, and elevator. Some plants also had augers, conveyors, and bagging equipment.

Total equipment costs generally ranged from $10,000 to $20,000 a plant.

Maximum capacity of plant and equipment was generally rated at 15 to 20 tons an hour.

Ingredients.--All plants used four ingredients--diammonium phosphate (18-46-0), ammonium nitrate (33.5-0-0), triple superphosphate (0-48-0), and muriate of potash (0-0-60).

All ingredients were in granular form. Plants had ingredient storage capacity for about 1 week's supply during the busy season. Five plants were equipped to receive ingredients in hopper cars. Eight received all ingredients in boxcars.

Major problems in receiving and handling ingredients were scheduling cars to arrive at the proper time, damaged cars and material shortages, and the necessity of using the same equipment for the blending operation as for unloading.

Volume.--Volume of plants operating more than 1 year averaged about 2,440 tons, or $190,000.

Bulk blending is a highly seasonal operation, with May accounting for 42 percent of the year's business in 1962-63. However, peak periods varied from 2 to 8 weeks. During such periods, plants operated 12 to 20 hours a day. Efforts were being made to minimize seasonality of operation by giving fall discounts. Two plants actually had a larger volume in the last half than in the first half of 1962-63.

Bulk blending plants must have adequate volume for efficient operation. A volume of 2,500 to 3,000 tons a year is needed for really efficient operation.

Potential volume should be determined before erecting a plant. Competition and overexpansion could lead to excessively high unit costs because of a shortage of patrons.

Spreading.--All plants offered a spreading service through local cooperatives, which delivered about 75 percent of the plant volume and spread it on the farms. Spreading charges ranged from 50 to 85 cents an acre, if the local provided the equipment and applied the fertilizer. Spreader rental charges to farmers ranged from 25 to 30 cents an acre.

Soil Sampling.--All plants offered a soil sampling service. On the average, each plant manager took about 500 samples in 1963. Charges for the soil sampling service usually were sufficient to pay for the laboratory analysis.

Samples were all analyzed by a State agricultural experiment station or licensed laboratory. Recommendations were made by a county agent or the experiment station. About 25 percent of the blending plant patrons used the sampling service, and about 80 percent of those using the sampling service purchased their fertilizer from the cooperative.

Soil Fertility Planning.--Some blending plant managers and some managers of local cooperatives were offering patrons a complete crop planning and soil fertility program. This included not only soil sampling, farm mapping, making fertilizer recommendations based on specific crop needs, and maintaining crop records, but also advice on crops to be grown, seed varieties to use, and assistance in using chemical insect and weed controls.

Plant Management.--Most plant managers were fertilizer and crop specialists. Of the 13 managers of plants surveyed, 9 had degrees from agricultural colleges. Managers generally were well qualified. Almost all had previous experience in related areas of work, such as teaching vocational agriculture, serving as county agents, or managing other farm businesses.

Basic pay of the managers ranged from $5,400 to $7,000 a year. However, fringe benefits in some cases amounted to another $2,000 a year or more. Plant managers were all employed on a year-round basis; some, however, served as field representatives for the regional cooperative in the off season.

Other Employees.--Half the plants had a second man throughout the year. All plants had at least one employee in addition to the manager during the busy season. A major problem in this type of operation is obtaining qualified help for a short season. The annual cost of part-time help averaged about $500.

Plant helpers who were hired on a year-round basis were generally more qualified than seasonal helpers. They were able to operate the plant alone and assisted in taking soil samples and promotional work. Cost of year-round helpers ranged from $3,500 to $5,400 a year.

Farmers' Reactions.--Based on reports from plant managers, farmers' reactions to the program have been quite favorable. They especially like the services associated with it. Through the bulk blending program, farmers are becoming more informed about fertility and cropping methods. They are increasing yields and profits, obtaining extra services, and getting quality fertilizer competitively priced.

Farmers generally must be sold on the program. Some problems in getting farmers to use the bulk blending program are: (1) They are generally accustomed to handling fertilizer in bags rather than bulk; (2) they are accustomed to using certain grades; (3) they are accustomed to buying fertilizer by the ton; and (4) they are used to buying fertilizer mixed in traditional specialized plants.

Attitudes of Local Cooperatives.--Bulk blended fertilizer was sold through local cooperatives--much of it through the cooperative located in the same town as the plant. Local dealers provided delivery and spreading services but were relieved of the inventory handling costs.

Local cooperatives using the program were generally pleased with it. The normal effect of the bulk blending plants' sales was to decrease the locals' bag sales somewhat, but to increase total fertilizer sales and at the same time to reduce fertilizer handling costs.

Evaluation of the Program.--Bulk fertilizer blending has been growing at a rapid rate in the last 5 or 10 years. The number of blending plants in the United States increased from only a few in 1955 to about 1,000 in 1963. Factors contributing to this growth were: (1) Services offered; (2) low cost; (3) labor saving on farms; (4) increasing interest in broadcast application; and (5) lack of fertilizer manufacturing facilities in the area.

Cooperatives played an important role in developing bulk fertilizer blending in the upper Midwest. They have been pioneers in developing educational programs and offering services such as soil sampling. They account for over one-third of the blending plants in the area.

While bulk blending is increasing, it is only one of many developments taking place in the fertilizer industry. Factors which will tend to limit the growth of bulk blending are: (1) Limited geographic adaptability; (2) improvements being made in liquid mixes; and (3) use of three-hopper trucks, which can make broadcast applications of individual plant nutrients. However, the benefits of the program in many areas seem to indicate that bulk blending will continue to attract more farmers in the immediate future.

Suggestions for Improvement.--Bulk blending services of some plants could be improved by strengthening educational programs with farmers, offering a complete service, developing more efficient delivery and spreading services by using nurse trucks and tote boxes, evening out sales peaks, and possibly by adding a full-time assistant to the manager.

Cooperative Bulk Fertilizer Blending In The Upper Midwest

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The fertilizer industry is undergoing continuous change. Fertilizer production, marketing, and consumption practices have all changed tremendously in the last 10 years. Among the recent developments is the rapid growth of bulk fertilizer handling. Bulk blending is one of the rapidly expanding bulk handling methods. Basically, bulk blending is the mixing of two or more dry, and usually granular, ingredients according to the farmer's specifications.

Bulk blending of fertilizers began about 10 years ago. By 1963, the number of plants in the United States was about 1,000. These bulk blending operations are having a significant impact on the fertilizer industry and on farm fertilizing practices.

The distributor likes the way bulk blending reduces transportation and handling costs. Basic ingredients are shipped from the primary producer to a local blending plant where they are mixed and sold directly to the farmer. This eliminates the wholesaler in the distribution chain. However, such a program increases the work of the producer, who must deal with hundreds of local plants instead of only a few regional mixing plants.

The bulk blending program also has an impact on the farmer and his use of fertilizer. Bulk blending provides the farmer with his exact fertilizer needs. It gives him plant nutrients at a cost competitive with other fertilizer, but most significantly it offers fertilizer service.

Bulk blenders generally provide the farmer with a complete soil fertility program. They take samples of the farmer's soil, send them to a college or private laboratory for analysis, draw farm soil maps, maintain crop records, make fertilizer recommendations, mix ingredients in the exact ratio desired, and deliver and spread them on the farmer's field. All this is done at a price competitive with fertilizer sold by other dealers in the area who do not provide all of these services.

Note: The author wishes to express his appreciation to the officers and employees of Farmers Union Central Exchange, Inc., St. Paul, Minn., and Midland Cooperatives, Inc., Minneapolis, Minn., for their excellent cooperation and helpful assistance in providing information useful in preparing this report, and to the members of the staff of the Division of Agricultural Development, Tennessee Valley Authority, and the Agricultural Stabilization and Conservation Service, U.S. Department of Agriculture, who assisted in preparing this report.

Farmer Cooperative Service (FCS) and Tennessee Valley Authority (TVA) were interested in studying cooperative fertilizer blenders who have demonstrated success in merchandising fertilizer through programs based on service and education. The blending programs of two regional cooperatives--Farmers Union Central Exchange, Inc., St. Paul, Minn., and Midland Cooperatives, Inc., Minneapolis, Minn., were studied.

TVA was particularly interested in an analysis of the operations of these two wholesale distributors because they had participated with TVA in a distributor demonstration program since 1947. The distributor demonstration program has placed strong emphasis on education of local dealers as a means of increasing farmers' knowledge of fertilizers and assisting them in obtaining optimum returns on fertilizer investments.

This study should be helpful to cooperative and other blending plant operators in evaluating and improving their operations.

Purpose and Method of Study

The purpose of this report is to provide to management of farmer cooperatives and others information that will be helpful in adjusting to the economic impact of bulk fertilizer blending on the cooperative fertilizer distribution system. The report contains an analysis of bulk blending facilities and operations of 13 plants and provides suggestions for improvement of existing operations. Such information could be of help to other cooperatives considering bulk blending in the future.

Although this study was based on bulk fertilizer blending operations of two regional farmer cooperatives in the upper Midwest, there are other blending plants in that area and in other parts of the country that have different facilities, equipment, and operating practices. This study, therefore, does not attempt to discuss all types of blending operations in the area.

This report emphasizes the service, volume building, and educational aspects of bulk fertilizer blending operations. It is based on personal interviews with 12 managers of 13 bulk blending plants--9 in Minnesota, 2 in Wisconsin, 1 in South Dakota, and 1 in Iowa. Seven plants were selected from 24 owned and operated by Farmers Union Central Exchange and 6, from 31 operated by Midland Cooperatives. (fig. 1). Plants studied are those identified by the location of each. They present a cross section of managerial ability and operating success.

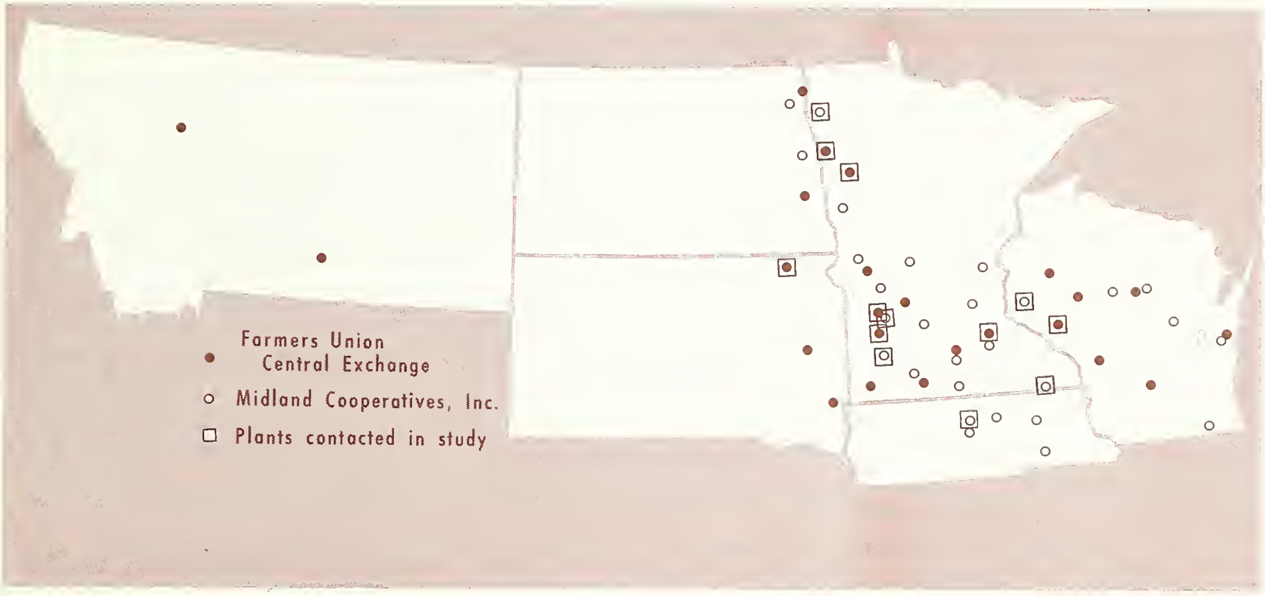
The 13 plants have been in operation from 2 to 5 years. In 1962-63, they blended an average of about 2,400 tons each.

Specifically the report covers: (1) Facilities and equipment used; (2) cost of operation; (3) operating practices; (4) responsibilities of management; (5) services offered; and (6) suggestions for improvement.

Development of Bulk Blending

Dry bulk mixing of pulverized ingredients into grade fertilizers has been going on for many years; therefore, the process is not completely new. Bulk blending as known today is really an adaptation of a conventional dry mixing plant. Bulk blenders nearly always

Fig. 1-- LOCATION OF BULK BLENDING PLANTS OPERATED BY FARMERS UNION CENTRAL EXCHANGE INC., AND MIDLAND COOPERATIVES, INC.


● Farmers Union Central Exchange
○ Midland Cooperatives, Inc.
☐ Plants contacted in study

use granular ingredients; they normally do not formulate grades; they are located in the farming community; and they distribute their fertilizer directly to the farm. The real difference in dry bulk mixing and bulk blending is bulk distribution.

A recent survey by a farm chemicals magazine indicates that bulk blending will continue to increase in the coming years. Fertilizer dealers surveyed expected a greater growth in bulk blending within the next 5 years than in any other method of fertilizer distribution.

Bulk blending has increased rapidly in spite of the fact that it had to compete with some liquid mixed fertilizers being used in the Upper Midwest before bulk blending really got underway. Some of the factors that contributed to the rapid growth of bulk blending in the area were:

1. Bulk blending was usually sold as a complete crop fertility program.

2. Bulk blends cost less than liquid mixed fertilizers.

3. There was a growing interest in broadcast fertilizer application and fall plowdown.

4. Fertilizer manufacturing facilities were lacking in the Upper Midwest.

5. Less fertilizer was being used there than in some other areas of the country; therefore, there was a great potential for increasing fertilizer consumption in this area.

Cooperatives have been pace setters in blending bulk fertilizer. They account for over one-third of all bulk blending plants in Iowa, Wisconsin, Minnesota, and Illinois. They are leaders in the educational program to instruct farmers on the benefits of high-analysis fertilizer, application according to soil test recommendations, topdressing, and use of fall and winter applications.

Development by Regional Cooperatives

Farmers Union Central Exchange, Inc., and Midland Cooperatives, Inc., both regional cooperatives, are typical examples of cooperative pioneering in bulk blending in the upper Midwest.

In 1955, Farmers Union Central Exchange, decided that something had to be done to provide farmers with a new type of fertilizer distribution system--a program that would further automate the farmers at no additional expense as well as further educate them in the use of fertilizer. Out of this idea grew the Exchange's prescription-mix program, which now comprises 24 soil service centers. The Exchange also serves eight plants owned by local associations.

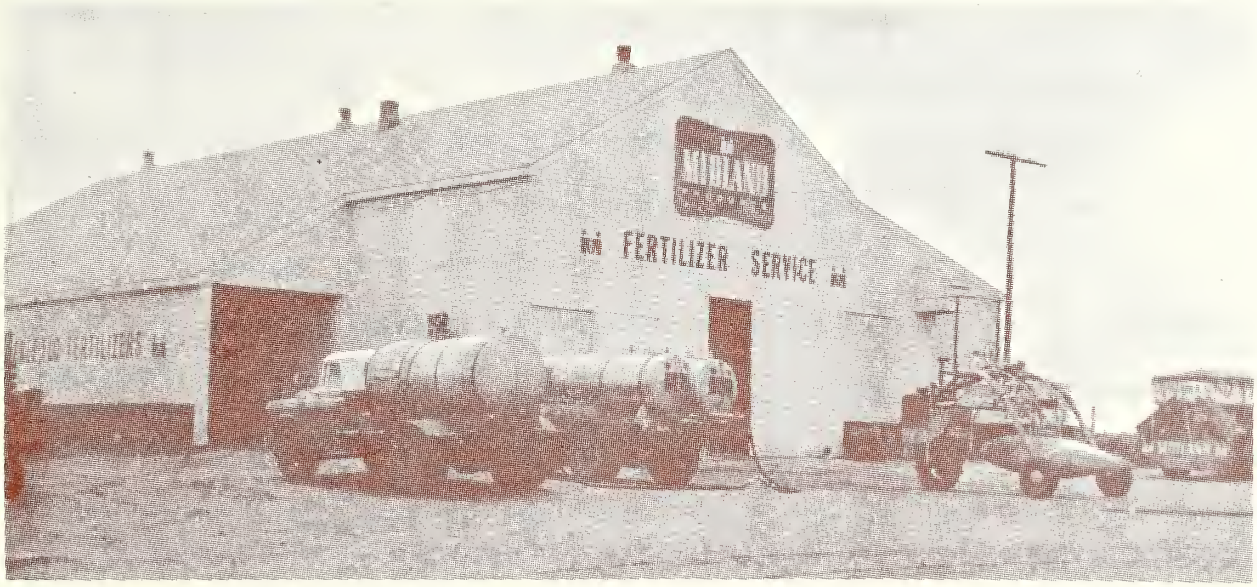
Midland Cooperatives started planning its bulk blending program in 1953 and built its first plant in 1955. Right from the start, Midland made sure its bulk fertilizer service would give patrons the exact analysis and amount of fertilizer they needed rather than what salesmen could sell them. Midland has continued to emphasize a complete crop management program in its bulk blending operations, which now consists of 31 plants, either owned or serviced by the regional.

Relationship to Local Cooperatives

All fertilizer handled by the 13 blending plants is sold through local cooperatives.

The local associations served are independent cooperatives affiliated with the two

A bulk blending plant operated by Farmers Union Central Exchange, Inc., St. Paul, Minn. Spreader trucks and a trailer are in the foreground.



A typical bulk blending plant operated by Midland Cooperatives, Inc., Minneapolis, Minn. Liquid fertilizer delivery and spreading equipment and a dry bulk spreader truck are in the foreground.

regionals that own and operate the blending plants. The local associations are under no obligation, however, to purchase fertilizer from the regional's blending plants. Farmers cannot purchase fertilizer directly from the blending plant.

Local patrons place their orders through their local cooperatives and the cooperatives deliver and spread the fertilizer, if the farmer wants this done. However, the locals receive a fee for providing this service.

The blending plants usually provide the soil sampling service, encourage the farmer to use the program, determine his fertilizer needs, and maintain the inventories. Thus, the local associations are relieved of much of the fertilizer handling job.

Area Served by Blending Plants

In 1962-63, the plants were generally serving an area with a 25- to 50-mile radius, as shown in the accompanying tabulation:

Radius of territory in miles	Number of plants reporting
Under 15	1
16 - 25	1
26 - 35	6
36 - 45	2
Over 45	3

Crops on which blended fertilizers were most frequently used in this area in 1962-63 were small grains, corn, and hay, as shown in the next tabulation:

Crop	Number of plants reporting a major share of their output used on specified crops
Small grains	11
Corn	10
Hay	8
Sugarbeets	4
Pasture	2
Potatoes	2

The 13 blending plants studied were serving a total of 149 local cooperatives. As the next tabulation shows, 7 of the 13 plants were serving between 11 and 15 associations. However, for most blending plants a few nearby associations accounted for most of the business.

Local cooperatives served	Number of plants reporting
1 - 5	2
6 - 10	2
11 - 15	7
16 - 20	2

The plants were serving from 100 to 700 patrons each. All of these patrons were members of affiliated cooperatives in the blending plants' area. However, a large proportion were members of a few of the cooperatives that were located a short distance from a plant.

Cooperatives frequently have been among the first fertilizer dealers in an area to provide a bulk fertilizer blending service. However, at the time of the study most plant managers reported that other blending plants (usually from two to four) were operating in the same area.

Plant Operations

Plant operations can be divided into the following four kinds:

1. Receiving ingredients.--Incoming ingredients were received in hopper cars or boxcars. Those received in hopper cars were unloaded and moved to the storage bins with an auger-elevator-conveyor system. Those received in boxcars were removed with a payloader and either moved directly to the storage bins or fed into an auger-elevator-conveyor system.

2. Calculating the blend.--The first step in the blending operation was determining the ingredients for the blend. For this a machine calculator and operator were used. The blend could also be formulated by using a "FORMU-CHART" prepared by TVA.

3. Blending the ingredients.--All plants used a batch mixing system. Ingredients were (1) removed from the storage bins with a payloader; (2) weighed and fed into the mixer, or fed into a scale hopper and then into the mixer; (3) mixed with a ribbon or rotary mixer; and (4) loaded into a waiting truck or spreader.

4. Delivery and spreading.--Local associations provided the delivery and spreading services in the businesses studied. They used two types of spreaders--6- to 7-ton spreader trucks and 1 1/2- to 4-ton spreader trailers.

Buildings

Buildings at the plants studied were neat, efficient, and simple. All were basically of wood construction with concrete floors. Ten plants were typical frame gable construction and three were quonset structures. All were either rectangular or L-shaped with approximately 4,000 to 5,000 feet of floor space. The range in cost of the buildings was from about $10,000 to $50,000. Figure 2 is a typical blending plant flow-chart, while figure 3 shows a typical plant layout.

All plants were located on a rail siding. Each was on about 1 or 2 acres of owned or leased land.

The major portion of the inside of the plants--about two-thirds or three-fourths--was used for ingredient storage. Storage bins were usually located along one side of the building with a loading and work area on the other side. The office and mixing equipment were generally at one end.

Most plant managers were satisfied with the buildings. However, a few mentioned that in humid weather concrete floors became quite slippery. This created a special problem where floors were not level.

Another construction problem observed was that exterior wall construction was often not sufficiently rigid to hold the heavy material, and walls frequently bulged. Some plant managers attempted to avoid interior bin wall bulging by keeping adjoining bins filled to about the same level. Heavier or more rigid exterior wall construction, however, seems essential, not only to avoid accelerated depreciation and increased maintenance costs, but also to prevent a working hazard should a wall collapse.

Equipment

Bulk blending plants require only a modest investment in equipment. The plants surveyed generally had from $10,000 to $20,000 in one or more of the following equipment items: A mixer, an elevator, a scale, and a loader. Those plants, equipped to receive ingredients in hopper cars, also had augers and conveyors. Some plants also had bagging equipment.

There were two general types of mixers--the ribbon mixer and the rotating mixer. Ribbon mixers generally cost somewhat less than rotating mixers, and the capacity was less.

All plants used front-end loaders to transfer materials from the ingredient storage bins to the mixer--referred to as charging the mixer. Cost of new loaders ranged from $2,800 to $6,000. Loaders also were used for

Fig. 2--FLOW CHART OF TYPICAL BLENDING PLANT

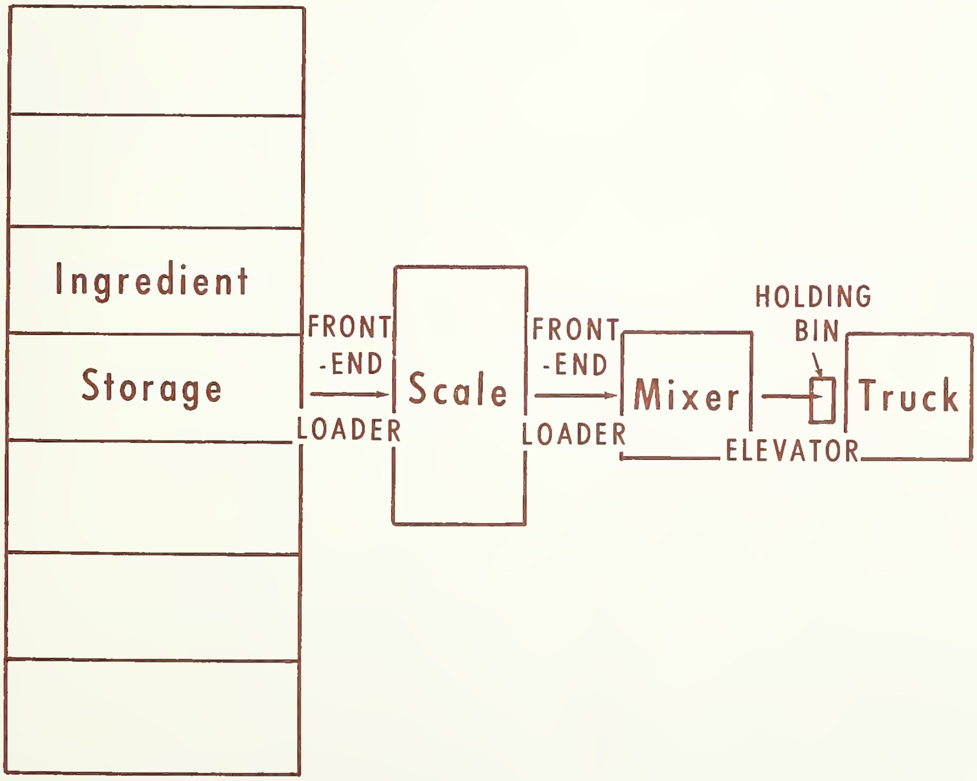
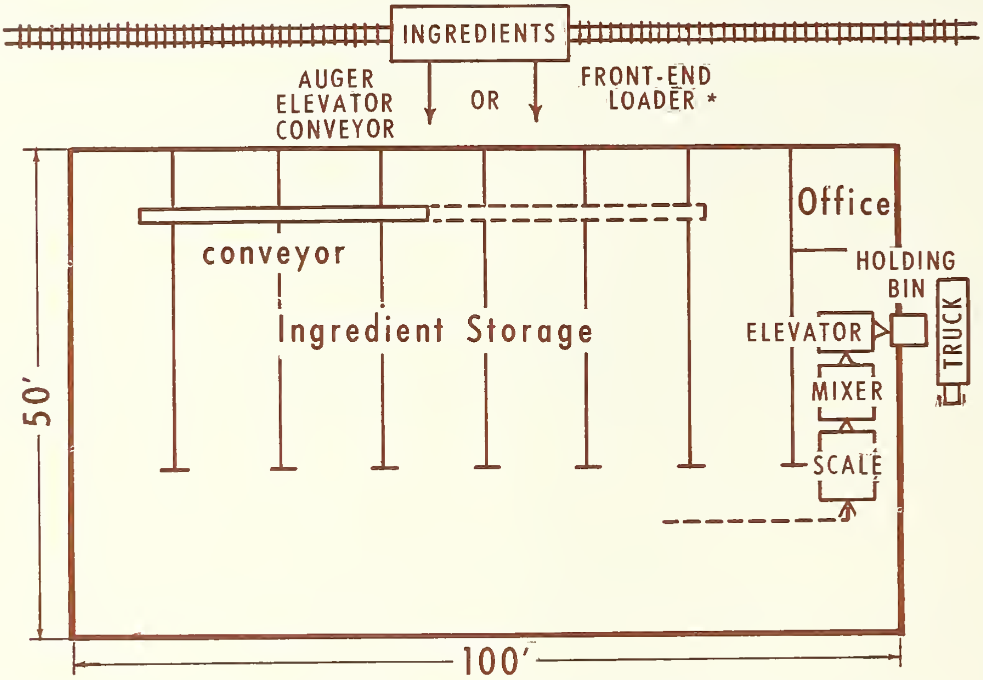


Fig. 3--TYPICAL LAYOUT OF BULK BLENDING PLANT



*Front-end loaders either transferred material directly into storage bins or fed material into a floor hopper, elevator conveyor system.

unloading ingredients in plants that were not equipped to handle hopper cars.

All plants had at least one elevator. Several had two or more. Elevators were used by all plants in the mixing operation either to (1) elevate ingredients to a raised mixer from which the mixed material was emptied into a spreader truck, or (2) elevate the mixed material from a floor level mixer into either a spreader truck or a holding bin.

Some plants also used elevators for handling incoming ingredients. Such plants had belt conveyors to transfer ingredients from the elevator to a storage bin. Conveyors had a capacity of 35 tons an hour and cost from $4,000 to $5,000.

Some plants also had one or two holding bins in which to store mixed fertilizer temporarily. This permitted continuous operation of the plant even though the spreader truck was not ready to load.

Up to the time of the study, none of the plant managers had experienced any major problems with equipment. A frequent problem with ribbon mixers was material buildup as moisture and action of the mixer caused a hard coating to form on the bottom of the mixer. Several managers reported they corrected this problem by raising the ribbon from its original one-fourth inch clearance to one-half inch. This also seemed to reduce particle breakdown. Particle breakdown and segregation sometimes occurred from overblending. Thus, to minimize the mixing time, most plant operators did not start mixing until the batch was completely charged.

Fertilizer is a highly corrosive material. Thus, equipment must be well cared for to avoid rapid deterioration. Most plants included in the study did an excellent job of preventive maintenance. All equipment was clean and had been recently painted. In fact, the excellent care of plant and equipment was as impressive as any part of the program.

Ingredients

All of the plants studied used four ingredients: Diammonium phosphate (18-46-0); ammonium nitrate (33.5-0-0); triple superphosphate (0-48-0); and muriate of potash (0-0-60). All ingredients were granular.

Ingredients were shipped directly from the basic producer to the blending plant as needed. They were not stored at an intermediate location by the regional cooperative. Instead the regional's buyer placed orders for ingredients on the basis of orders already submitted by the local plant managers.

Since the blending season lasts only a few weeks and the plants have limited storage, this method of distribution places a considerable additional burden on the basic producer. He must process and ship more orders in a shorter time than with the normal distribution system. The basic producer also must store the material most of the year rather than rely on an intermediate mixer to purchase and store it throughout the year.

While the basic producer would no doubt give discounts to buyers who placed large orders and purchased and stored the material, it is doubtful that such discounts would be sufficient to get the regional to store materials.

Most plant managers reported they had storage space for only about a 5-day supply during the peak blending period. Thus, maintaining an adequate inventory during this period could present a problem. Orders had to be placed 10 days in advance of receipt of shipment. Therefore, ordering had to be based primarily on experience. A problem sometimes arose in rainy weather when sales were down, and cars that had been ordered 10 days earlier arrived with no storage space available. This meant that demurrage had to be paid on the cars or they had to be diverted to another plant.

Generally, it seemed more economical to limit storage space and take a chance on paying demurrage or diverting the cars. The regional buyer is a great help in diverting shipments from one plant to another and minimizing these inventory problems.

Most plant managers attempted to keep the bins filled during the busy season; and since this season often ended as abruptly as it started, many found their bins filled or nearly filled at the close of the peak season. Some savings could be realized, of course, by ending the season with a low inventory. With more experience, plant managers may become more adept at estimating the amount of ingredients needed and the possible carryover.

Most plant managers were satisfied with ingredient materials. They reported that the ingredients mixed well and did not segregate. Some managers reported that farmers had problems adjusting their spreaders--if the plant changed its ingredients source--because of variations in density of ingredients received from different suppliers.

Five plants were equipped to receive ingredients in hopper cars. They had undertrack augers carrying materials to an elevator, which dropped the ingredients directly into bins or onto a conveyor which moved them to the bins.

Use of hopper cars could create a problem because railroads are not required to furnish them to the plants. Therefore, all plants equipped to receive ingredients in hopper cars could also receive them in boxcars and use a front-end loader to drop material into a floor hopper and auger. However, all but one plant equipped with undertrack augers received 90 to 100 percent of their ingredients in hopper cars. One received only 25 percent in hopper cars.

Seven plants received all ingredients in boxcars. Ingredients were removed from the boxcar with a front-end loader and either dumped directly into the bin or into a floor hopper and elevated and dropped or conveyed into the bins.

Worker is removing ingredients from storage bin with a front-end loader.

Unloading a boxcar was usually faster than unloading a hopper car but required the use of a front-end loader and the full time of one man. While auger unloading required a little more time, it did not require a loader or full-time attention. However, auger unloading required considerable attention to avoid blocking, and to be certain material was flowing out of the car.

Several managers indicated that, where the same elevator was used to fill bins as to mix or load blended material, a problem arose because cars could not be unloaded until the day's blending was completed. This was also true of front-end loaders when the same one was used to charge the mixer and unload the boxcar.

A problem frequently mentioned in receiving ingredients was damaged boxcars. About one-half of the plant managers mentioned that cars were short of ingredients because of the poor condition of the cars. One manager said he received a car that was less than half filled. Other problems mentioned in connection with receiving ingredients were trash of various kinds in the car and difficulty in getting cars when they needed them.

Volume and Operating Results

Bulk blending plants must have an adequate volume to operate efficiently. The following section presents facts on volumes of the 13 bulk blending plants with their operating costs and margins.

Volume

In 1962-63, the average volume for those plants which had been operating 2 or more years was 2,400 tons. This was about 400 tons less per plant than in 1961-62. In 1962-63, one plant had less than 1,000 tons, 5 had 1,000 to 2,000 tons, 4 had 2,000 to 3,000 tons, and 3 had over 3,000 tons.

Volume, as previously mentioned, is seasonal. Of the total volume of these plants in 1962-63, 42 percent was blended in May and 17 percent in April (table 1). Thus, nearly 60 percent of the year's business was handled in April and May. These plants were attempting to increase movement of fertilizer in the fall, and with some success. Two plants actually sold more fertilizer between July 1 and December 31 than in the first half of the year.

Table 1.--Seasonal variation in fertilizer blending, 13 cooperative bulk fertilizer blending plants, upper Midwest, 1962-63

Month	Annual volume blended by months	
	Average	Range
	Percent	Percent
January	1	0 - 2
February	1	0 - 2
March	2	0 - 5
April	17	8 - 35
May	42	25 - 75
June	7	0 - 25
July	3	0 - 10
August	2	0 - 6
September	4	0 - 15
October	14	2 - 28
November	6	0 - 14
December	1	0 - 4
Total	100	

The seasonal nature of the operation also has a significant effect on volume. Managers repeatedly said that if there was rain during May, their fertilizer volume for the year could be cut as much as 50 percent. Farmers would either obtain bagged fertilizer somewhere else or omit fertilizer completely if fields were too wet to apply it when they wanted it.

Seasonality and length of season were the major problems facing managers of blending plants. The difficulty of predicting when the rush season would begin, or even if there would be one, created some uncertainty. It also made ordering ingredients and obtaining temporary help difficult.

In terms of sales, volume dropped from an average of $221,635 in 1961-62 to $189,886 in 1962-63 (table 2). Major factors contributing to reduced 1962-63 volume were unfavorable weather conditions and increased competition. The 1963-64 volume, however, was expected to be somewhat greater than in 1962-63.

Operating Costs and Margins

Despite the smaller volume of business in 1962-63, operating expenses actually increased by more than $1,000 a plant--from $22,580 in 1961-62, to $23,667 in 1962-63 (table 2). Thus, operating costs per ton of output increased by almost $2--from $7.97 in 1961-62 to $9.74 in 1962-63. Such costs were 10.2 and 12.5 percent of sales in the two respective years.

Table 2 also shows a breakdown of expense items. The major cost item in 1962-63 was salaries, amounting to $10,494 a plant, or $4.31 a ton. They accounted for about 45 percent of total expenses in 1962-63. The next item was depreciation, $4,809 a plant, or $1.97 a ton. Taxes were 67 cents a ton and insurance 60 cents a ton.

Economies of scale are quite evident in this type of operation, where almost all

Table 2.--Volume and operating statements, nine cooperative bulk fertilizer blending plants, upper Midwest, 1961-62 and 1962-63

Item	Average per plant		Average per ton	
	1961-62	1962-63	1961-62	1962-63
Total tons delivered	2,829	2,436	--	--
Total sales and transfers	$ 221,635	$ 189,886	$ 78.36	$ 77.95
Cost of sales	180,601	153,277	63.85	62.92
Gross margin	41,034	36,609	14.51	15.03
Expenses:				
Salaries	10,023	10,494	3.54	4.31
Payroll taxes	310	347	.11	.14
Depreciation	4,736	4,809	1.67	1.97
Travel	437	572	.15	.24
Office expense	347	285	.12	.12
Telephone & telegraph	458	414	.16	.17
Insurance & bonds	1,219	1,461	.43	.60
General taxes	1,333	1,627	.47	.67
Rental	445	390	.16	.16
Repairs & replacements	1,011	816	.36	.34
Light, water, power, and heat	356	465	.13	.19
Gasoline, oil, and greasing	821	573	.29	.24
Demurrage and miscellaneous freight	3	353	.00	.15
Interest on borrowed funds	451	505	.16	.21
Miscellaneous[1]	630	556	.22	.23
Total expenses	22,580	23,667	7.97	9.74
Operating margin	18,454	12,942	6.54	5.29
Other revenue	1,502	841	.53	.35
Total net margin	19,956	13,783	7.07	5.64

[1] Includes some incentive payments to employees.

costs are fixed. A 1962-63 comparison of a relatively low-volume plant--1,550 tons annually--and a relatively high-volume plant--4,250 tons annually--illustrates this quite clearly (table 3). The low-volume plant had total operating costs of $21,961, compared with $24,703 for the high-volume plant. Total operating costs for the high-volume plant were only about 10 percent greater than for the low-volume plant. On a tonnage basis, the low-volume plant's costs were $14.16 a ton, compared with $5.82 a ton for the high-volume plant. Costs for mixing a ton of fertilizer in the low-volume plant were about 2.5 times as great as those of the high-volume plant.

Because of higher gross margins in the high-volume plant, the net margin difference between the high- and low-volume plants was even greater than the cost difference. Net margins for the high-volume plant were

Table 3.--Comparison of operating costs, low-volume and high-volume cooperative bulk fertilizer blending plants, upper Midwest, 1962-63

Item	Average per plant		Average per ton	
	Low-volume plant	High-volume plant	Low-volume plant	High-volume plant
Total tons delivered	1,550	4,250	--	--
Total sales and transfers	$137,445	$356,233	$88.67	$83.82
Cost of sales	111,180	272,596	71.73	64.14
Gross margin	26,265	83,637	16.94	19.68
Expenses:				
Salaries	8,764	10,320	5.65	2.43
Payroll taxes	234	294	.15	.07
Depreciation	4,861	5,464	3.14	1.29
Travel	61	436	.04	.10
Office expense	100	308	.06	.07
Telephone & telegraph	272	474	.18	.11
Insurance & bonds	1,418	2,423	.91	.57
General taxes	2,114	1,887	1.36	.44
Rental	80	69	.05	.02
Repairs & replacements	86	247	.05	.06
Light, water, power, and heat	451	469	.29	.11
Gasoline, oil, and greasing	338	824	.22	.19
Demurrage and miscellaneous freight	2,124	197	1.37	.05
Interest on borrowed funds	400	500	.26	.12
Miscellaneous	658	791	.42	.19
Total expenses	21,961	24,703	14.16	5.82
Operating margin	4,304	58,934	2.78	13.86

$13.86 a ton, compared with $2.78 a ton for the low-volume plant. Thus, the high-volume plant had operating margins 4.8 times larger than those of the low-volume plant.

The relationship of costs and returns to volume of output is illustrated in figure 4. The chart shows costs and returns per ton, at different levels of output. Costs used are actual costs of the plants operated by one of the regionals in this study.

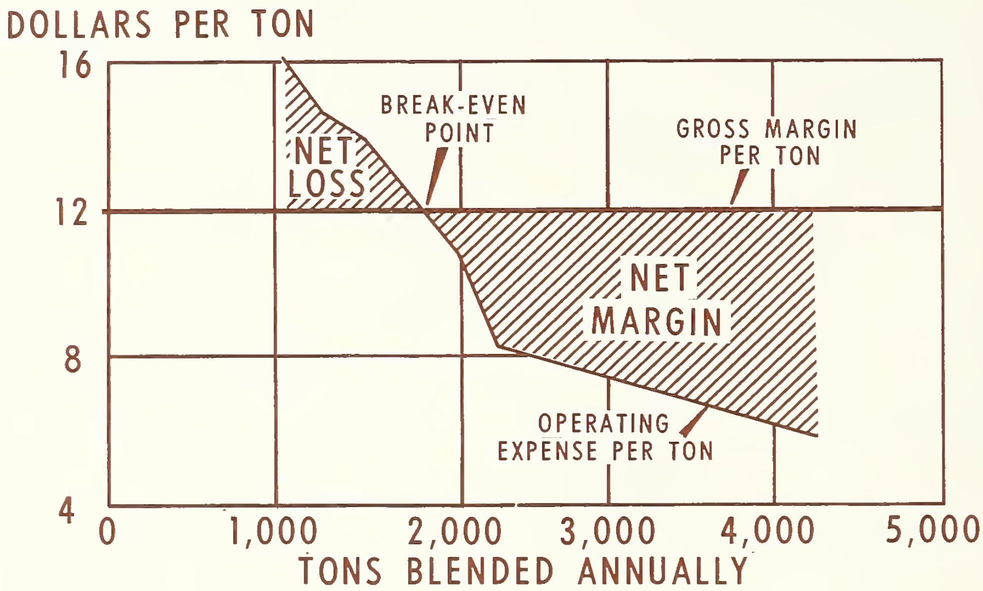
Blending operations of this regional were chosen because facilities, personnel, and services offered were quite uniform in each of its plants. Plants operated by the other regional varied considerably in all of these aspects.

Gross margin or markup per ton was held constant at $12. Therefore, net margin differences at different levels of output are a direct result of differences in costs of operation.

This chart shows that plants of the type operated by the regional would need a volume of about 1,900 tons annually to break even. With a gross margin of $12 a ton, the three lowest volume plants would operate at a loss. With a volume of 1,150 tons, the cost

Fig. 4--RELATION OF VOLUME TO BLENDING PLANT COSTS AND NET MARGINS IN ONE ASSOCIATION, 1962-63

BASED ON CONSTANT GROSS MARGINS OF $12 A TON



per ton is about $16. Thus, at this volume there is a net loss of $4 a ton. As volume rises, costs per ton decrease rapidly until output reaches about 2,500 tons. At this volume, costs per ton are only $8, leaving a net margin of $4 a ton. Increasing plant volume from 2,500 tons to 4,000 tons reduces costs by another $2 a ton and increases net margin to $6 a ton.

With increased competition and lower margins, a higher volume would be required to break even. For example, with a $10 markup, a volume of about 2,200 tons would be needed to break even; with an $8 markup, a volume of 2,600 tons would be required.

The comparison of these plants clearly illustrates that, in blending fertilizer, increasing the volume of plants operating considerably below capacity is almost certain to reduce unit costs and increase savings. Reduced costs and increased savings would likely continue until plant capacity is reached.

Management of Bulk Blending Operations

All bulk blending plants in this study were owned and operated by two regional cooperatives. One regional had an overall plant supervisor in the regional office, and all plant managers reported directly to him. The other regional had its plant managers report to an area fertilizer field representative. However, it also had a regional merchandise buyer who ordered ingredients and provided technical advice to plant managers.

Each plant had a full-time manager. The plants of one regional also had a full-time assistant and hired additional seasonal help, if needed. Those of the other regional had no full-time man in addition to the manager but relied solely on seasonal help to carry on plant operations.

Plant Managers

Managers of all plants were employed on a year-round basis; however, some of them also served as soils and crops fieldmen for the regional cooperative during part of the year.

Duties of the bulk fertilizer blending plant manager, according to those contacted, can generally be classified as (1) volume building, and (2) plant operation.

Most managers considered volume building as their major duty, because plant operation involved only a short period and could be carried on by less professional help. Thus, while the manager must be concerned about proper scheduling, maintenance, and all the other facets of plant operation, his primary concern is building a group of loyal satisfied patrons.

Volume building activities included making contacts with local cooperatives to provide them with an understanding of the program and encouraging them to sell it, and making contacts with farmers to explain and promote the program. Soil sampling has proven to be an extremely valuable device in making farm contacts, obtaining farmer confidence, and making fertilizer sales. However, other farm contacts to simply explain the program are also helpful.

The regionals included in this study had aggressive men as plant managers. Nearly all were less than 40 years old.

These cooperatives also generally selected men with professional training and technical knowledge of crops, soils, and fertilizer. Of the 12 managers, 9 had bachelor's degrees from agricultural colleges, usually in agricultural education or agronomy. Two managers held master's degrees.

Manager of a bulk blending plant is pointing out elevator legs to patrons.

Most plant managers previously had related experience in other agricultural fields. Four had been vocational agricultural instructors, two managed other bulk blending plants, and two managed other farm businesses. Only one started directly out of college.

Those managers who were most successful placed great importance on the volume-building aspect of their work, made many farmer contacts, took a large number of soil samples, worked well with people, and were enthusiastic about the program.

Basic pay of the plant managers ranged from $5,400 to $7,000 a year, as follows:

Annual salary	Number of plants reporting
$5,000 - $5,500	1
5,501 - 6,000	3
6,001 - 6,500	2
6,501 - 7,000	7

In some cases, fringe benefits such as personal use of company cars, net margin sharing, insurance, and the like, may have added another $2,000 to these salaries.

Other Employees

Each of nine plants--all but one operated by one regional--had a full-time assistant or second man (table 4). This employee was usually well qualified and capable of operating the plant by himself--including calculating the amount of each ingredient needed--and assisting farmers with soil test interpretation and fertilizer ordering. In the off season, the second man was responsible for plant and equipment maintenance and assisted in taking soil samples. Plant managers reported no difficulty in obtaining men for this job.

Table 4.--Number of employees in addition to manager, 13 cooperative bulk fertilizer blending plants, upper Midwest, 1962-63

Association code	Number of employees other than manager during:	
	Entire year	Peak season only
A	1	2
B	1	2
C	1	0
D	1	1
E	1	2
F	1	0
G	1	1
H	1	2
I	0	1
J	0	0
K	0	1
L	1	12
M	0	1

The additional cost of hiring a second man year round ranged from $3,000 to slightly over $4,500 a year as shown in the tabulation below.

Annual labor costs of:	Number of plants reporting
Full-time helpers:	
$3,000 - $3,500	1
3,501 - 4,000	3
4,001 - 4,500	1
Over 4,500	2
Total	7
Part-time helpers:	
$300 - $400	1
401 - 500	1
501 - 600	1
601 - 700	1
701 - 800	2
Total	6

Some of the reported advantages of having a full-time second man were: (1) A more capable person can be obtained for this position than for seasonal work; (2) the annual problem of searching for, and training, an equipment operator is avoided; (3) the second man can assist in making farm calls and taking soil samples; (4) a better job of plant maintenance can be done; and (5) the plant can provide better service to its patrons.

The six blending plants with no full-time assistants were faced with a problem of obtaining a man for a short time each year. The plant managers reported it was usually not too difficult to obtain and train a man to operate the payloader, but seasonal help usually was not able to operate the calculator, assist a farmer in determining the amount of fertilizer he needed, or determine the amount of each ingredient required to fill the farmer's order. Thus, it was usually necessary for the plant manager to be present to help the farmer and determine the ingredients needed. In a few cases, secretaries had been employed who were able to do this.

Most plants had no help in addition to the assistant or equipment operator. A few plants had a second helper or equipment operator, and a few had a secretary for a few weeks each year.

Base pay of the part-time helpers ranged from $1.15 to $1.50 an hour:

Hourly pay	Number of plants reporting
$1.15 - $1.25	3
1.26 - 1.35	3
1.36 - 1.45	4
Over 1.45	3

The annual cost of a seasonal or part-time equipment operator amounted to about $500 (tabulation, page 16.)

Total labor costs for the plants with a part-time helper usually were $6,000 to $8,000 a year. Labor costs of plants with a full-time helper were $10,000 to $12,000 a year.

Volume Building and Educational Activities

As stated earlier, the success of the bulk blending operation depends to a large extent on service and education. Because plant managers generally considered fertilizer volume building a major duty, they spent a large part of their time working with local cooperative personnel and farmers.

The importance of local cooperatives in building plant volume is clearly indicated by the fact that most of each plant's volume came through one or two nearby cooperatives who supported the program.

Farmers rely on local dealers for much of their fertilizer information. Thus, a fertilizer dealer's success depends on his knowledge of, and attitude toward, his program. Work with local cooperatives was intended to acquaint them with the program and enable them to provide their patrons with sound fertilizer information. This helped them sell fertilizer.

While plant managers could and did contact farmers personally, the number of farmers they could visit was limited. Thus, a plant could increase its farmer contacts several times by obtaining the active support of a local cooperative. The local manager had several advantages in making farmer contacts because he was familiar with the farmer and his fertilizer needs.

Plant managers worked with local cooperatives in several ways:

1. They trained local employees on all aspects of fertilizer and fertilizer marketing.

2. They helped make farm calls.

3. They attended annual meetings to discuss fertilizer use and crop needs.

4. They worked directly with patrons in providing crop and fertilizer advice.

5. They assisted local cooperative personnel in taking soil samples, drawing maps, and maintaining farm records.

In addition to their work with local cooperatives, the plant managers worked directly with farm patrons giving fertilizer advice, taking soil samples, and doing tissue testing. Plant managers averaged 400 farm visits each in 1962-63, as shown in the tabulation below. One manager called on more than 1,000 farmers during the year.

Number of farm visits	Number of plants reporting
200 - 400	4
401 - 600	4
601 - 800	1

Other service activities of plant managers included (1) conducting an open-house program in the spring each year before the plant began operating; (2) maintaining fertilizer test-plot demonstrations to clearly indicate fertilizer response; (3) tissue testing of crops with some nutrient deficiency; and (4) speaking to vocational agriculture classes and other groups.

In addition to the educational programs conducted by the plant managers and cooperatives, more education is needed. Six of the plant managers reported that more than half of their patrons still asked for a grade when buying fertilizer, although the program had been sold on the basis of plant food units, custom blending, prescription mixes, and fertilizer ratios. The percent of patrons asking for fertilizer grades was as follows:

Percent of patrons	Number of plants reporting
1 - 25	5
26 - 50	2
51 - 75	1
76 - 100	5

Eight of the plants reported, however, that over half of their fertilizer volume was blended on the basis of soil tests, as shown in the following tabulation. These included the farmer's own soil tests or soil tests of other farmers in the immediate area.

Percent of fertilizer	Number of plants reporting
0 - 25	2
26 - 50	3
51 - 75	4
76 - 100	4

Services Offered

Service is the key to the success of the bulk fertilizer blending program. Farmers are becoming more fertilizer conscious, and they have less labor available. They no longer merely buy fertilizer. They want a complete fertility or cropping program; and the fertilizer dealer who provides them with the best program, at a competitive price, will get the business.

The bulk blenders included in this study provided a complete fertilizer service. They based their program on service, and their success could be measured by the amount and efficiency of service given.

Their complete fertility program includes taking farm soil samples and sending them to a laboratory for analysis, maintaining crop and fertilizer records, making fertilizer and cropping recommendations, mixing fertilizer to the farmer's exact specifications, delivering the fertilizer to his farm, and spreading it on his fields.

All of the plants visited provided some of these services and some provided all of them.

Other services some of the plants provided were (1) liquid nitrogen application,

(2) tote box rental; (3) mixing micronutrients and insecticides with fertilizer; and (4) complete crop planning service.

Soil Sampling

Probably the most important service offered by the bulk blending plants is the soil sampling service. To date, it has been an effective method of obtaining patrons.

Many farmers are interested in having their soils tested, but few are willing to take the samples themselves. Thus, the cooperative which does soil sampling is providing an important service to the farmer. The farmer's interest in the soil sampling service is shown by the fact that about one-third of those getting fertilizer used this service.

In 1962, the 13 plant managers reported they sampled soil for an average of 120 farmers. Each farmer had about four samples. Thus, each plant manager took some 500 samples and sent them to an official laboratory for analysis. Seven managers took fewer than 500 samples; 4 took between 501 and 1,000; and 2 took between 1,001 and 1,500 samples.

Most farmers who had their soil tested applied fertilizer according to recommendations and most bought their fertilizer from the dealer who did the sampling. Of the 13 plants surveyed, 8 reported that 75 percent or more of the farmers whose soils they sampled purchased their fertilizer from the cooperative, as shown in the following tabulation.

Percent of patrons buying fertilizer after soil test	Number of plants reporting
0 - 25	1
26 - 50	1
51 - 75	3
76 - 100	8

Soil samples were generally taken by the plant manager or his helper, although in a

Bulk blending plant manager takes farmer's soil sample.

few cases professional samplers were employed. Samples were analyzed at the State agricultural experiment station or a licensed laboratory. Fertilizer recommendations were made by the county agent or the experiment station. The cooperative assisted the farmers in interpreting the soil fertilizer recommendations.

A small charge was usually made for the sampling service to pay for or help defray cost of the analysis. One manager said if no charge was made for the service, the farmer did not consider it worthwhile. Several plants that charged for the sampling service refunded the charge, if the farmer purchased his fertilizer from the cooperative.

The charge was not sufficient to cover all costs of providing the service. Most plant managers reported that charges did not cover half the costs. However, blenders considered this a good promotional technique and were not concerned about being reimbursed if they could get fertilizer orders. At the time of the study, an average of about 80 percent of the farmers taking advantage of the sampling service had purchased their fertilizer at the blending plants.

As farmers become more knowledgeable about fertilizer and as bulk blending becomes more competitive, they may shop around more. Thus, the present high percentage of fertilizer purchases by patrons using soil sampling services may not continue. One plant manager among the group included in the study reported that 80 percent of his sampling customers purchased fertilizer from the cooperative before 1962-63. In that year, only 50 percent did because of competitive conditions in the area.

Sampling a farmer's soil, therefore, was no assurance of obtaining his fertilizer business. One plant manager said he made certain he at least got to bid on the farmer's fertilizer order by withholding a copy of the soil map made by the plant until the farmer received the results of his soil test. In this way, the farmer was required to see the plant manager to determine the fields to which the recommendations applied, and at that time the plant manager could ask for his fertilizer order. Although the cooperative could not prevent the farmer from shopping further, it at least had the first opportunity of making the fertilizer sale.

Fertility Planning and Recordkeeping

When a soil sample is taken, a map and a cropping history of the field are made. In addition to drawing the soil maps, all of the plant managers interviewed provided farmers with forms to record crops grown, yields obtained, and fertilizer applied (appendix). These records were used as a basis for determining rates of fertilizer application for several years after a soil test was taken. Most plant managers reported that a soil test every 3 or 4 years was adequate; however, some took a test each year.

Some plant managers not only provided farmers with crop record forms but helped them maintain these records. Some managers even stored records in the office files so that they would be available if the farmer forgot to bring his copy when ordering fertilizer.

Most plant managers reported that few farmers maintained detailed crop records. Instead, they relied on records maintained by the cooperative as a basis for their cropping program.

The recordkeeping service of these cooperatives has been largely confined to the soil map and cropping history. However, both regional cooperatives had started offering a complete crop planning program for their patrons. These farmers needed help in planning their entire cropping program. The regional's service included advice on seed varieties and cultural practices to be used; for example, whether to use chemical pest controls, what kinds of chemicals to use, and when. The program could even include providing harvesting and marketing information. Thus, the fertilizer man of tomorrow must be more than a plant food salesman; he must be a complete crops management specialist.

None of the blending plants charged an extra fee for the recordkeeping service they were providing. This was generally considered a part of the soil sampling service and included in the sampling charge. As already mentioned, it was not sufficient to cover the cost of the service.

Delivery and Spreading

One of the essential features of a bulk blending operation is a spreading service. At all of the plants studied, such a service was available but usually through the local cooperative. Only one blending plant provided the spreading service. However, plant managers frequently arranged for local cooperatives to obtain equipment from other dealers when they were short.

The local cooperatives affiliated with the regionals included in this study delivered and spread about two-thirds of the regionals' plant output. The remainder was picked up by farmer-members of the locals. For six plants, more than 75 percent of the output was spread by the affiliated locals, as follows:

Percent of plant output delivered and spread	Number of plants reporting
0 - 25	1
26 - 50	4
51 - 75	2
76 - 100	6

Two types of spreaders were used--6- to 7-ton spreader trucks and 1 1/2- and 4-ton spreader trailers. Spreader trucks were always operated by the cooperatives; trailer spreaders were operated by the cooperative or rented by the farmer. Cooperatives, however, frequently found it necessary to have their own men operate the trailer spreaders because farmers tended to leave the spreader idle too much of the time.

All cooperatives charged for applying fertilizer. Charges were 50 to 85 cents an acre, as tabulated:

Spreading charge	Number of plants reporting
Per acre	
$0.50 - $0.64	4
0.65 - 0.74	3
0.75 - 0.84	4
Per ton	
$9.00	2

Two associations charged $9 a ton. Charges for spreader rental, if the farmer operated the equipment and used his own power unit, generally ranged from 20 to 30 cents an acre.

At the time of the study, nearly all of the bulk-blended fertilizer was delivered to the farm with a spreading unit. Some managers thought spreading equipment could be used more effectively if the spreader was placed in the field and a nurse truck used to haul material from the plant to it. This practice would keep the spreader busy spreading rather than being on the road or at the plant.

Only about 5 percent of the plants' output was delivered to the farm to be spread by the farmer. Thus, most of the one-third of the output not spread by the cooperatives was picked up at the plants by farmers. Much of this was used as a corn starter and applied with a corn planter attachment.

Farmers who picked up their own fertilizer received an allowance of $2 a ton plus 2 cents a ton-mile. Such farmers usually lived in the immediate vicinity of the plant.

Some plant managers thought they could increase their sales by offering a delivery service to farmers who desired to apply their own fertilizer. But in 1963, many of these farmers picked up their fertilizer in bags from other dealers because it was difficult to obtain delivery of bulk material from a blending plant and because the farmer then had to handle it in the field.

Providing Bulk Storage Depots

Until recently, all bulk-blended fertilizer was moved directly from plant to farm without intermediate storage. In fact, this has been one of the distinctive features of the program and an almost essential part of custom blending.

Many bulk blenders now believe, however, that inability to mix fertilizer in advance limits plant capacity. As a result, six plants studied were serving bulk supply depots owned by local cooperatives in outlying sections of the plant's territory at the time of the study.

While bulk storage depots require an adjustment of the custom-blend or prescription-mix idea, soil conditions are frequently quite similar in an area and much of the land will require the same ratio of fertilizer ingredients. Some plants contacted reported that 50 percent or more of their volume was in one ratio, such as 1-4-4, and several managers said that two or three ratios accounted for from two-thirds to three-fourths of their total business.

Since a large proportion of the plant volume frequently is in a few common ratios, these could be mixed in advance and stored. This would permit the plant to mix less common ratios when requested; permit the plant to more adequately serve outlying areas; even out peak seasonal periods; and should make better use of plant capacity and reduce unit handling costs.

Blended fertilizers which are stored must be registered grades in Minnesota. No information on such provisions was obtained in the other States.

All materials are weighed before they are fed into the mixer, and in many plants, again after the truck is loaded.

In many cases, rather than supply local bulk depots with fertilizer from the blending plant, it may be more efficient to supply them with grade fertilizers from the regionals' basic manufacturing plants.

One of the regional cooperatives in the study is actively encouraging affiliated local associations to build fertilizer supply depots. Advantages to the local cooperative and the farmers are: (1) Prompt service--the ability to supply a patron the volume of fertilizer he wants when he needs it; (2) lower costs--through storing and handling bulk goods; and (3) flexibility--since spreaders can be used more efficiently because of shorter delivery distances, or the farmer can pick up the blended fertilizer only a short distance from his farm.

This cooperative reported that a bulk storage depot 24 x 60 feet could be built at a cost of about $4,000. A tractor loader might cost from $300 to $500; a 4-ton trailer spreader, about $1,400; and if a local scale is not available a scale costing about $2,500 would be needed. A liquid fertilizer applicator and nurse tank could be added for another $1,500. This would bring the total cost of the bulk storage depot and necessary equipment to about $10,000.

Renting or Selling Tote Boxes

Some bulk blenders have used tote boxes as a means of hauling blended fertilizer to the farmer. None of the blending plants in this study rented or sold them, but three local cooperatives used tote boxes of steel, corrugated paper, and 3/4-inch plywood.

Plant managers indicated that other cooperatives thought such boxes offered a possibility for making better use of hauling and distributing equipment. However, plant managers generally were not favorably impressed. Some reported the boxes were too costly and time-consuming to be effective in reducing fertilizer handling costs.

Mixing Insecticides and Micronutrients in Blend

All of the bulk blending plants would mix insecticides and micronutrients with fertilizer, if requested. However, only a few farmers asked to have such materials added to their fertilizer.

Handling Liquid Nitrogen

Liquid nitrogen has generally been a cheaper source of N than the dry nitrogen used in the blended fertilizer. Ten cents a pound was the going price of liquid nitrogen in the spring of 1963, compared with 13.3 cents for dry nitrogen. Liquid N was used almost entirely as a side dressing on corn.

Of the 13 bulk blending plants, 7 also handled liquid nitrogen (41 percent N). Six of these plants had 22,000-gallon storage tanks. One had no storage for liquid nitrogen but obtained tank cars on a 30-day trip lease.

Five of the seven plants applied all of the liquid nitrogen they sold. One applied 80 percent and the other 40 percent. Six associations charged $1 an acre and one charged $1.25 for applying liquid N.

Other Factors Affecting the Success of the Bulk Blending Program

This section of the report discusses pricing, competition, and fertilizer control laws and their effect on the success of a bulk fertilizer blending operation.

Bulk Blend Pricing

The regional priced its blended fertilizer on a delivered basis. If the farmer or the local cooperative picked it up, an allowance of $2 a ton plus 2 cents a ton-mile was given.

Bulk blends were priced on the basis of plant-food units. In 1963, the average sales price of the ingredients is shown in the tabulation on page 24.

While blended fertilizer was sold on the basis of plant-food units, the price also frequently was quoted on a grade equivalent-ton

Fertilizer ingredient	Average price per pound
	Cents
Nitrogen	13.3
Phosphorous	9.5
Potassium	5.2

basis. The cooperative would state the cost of the nitrogen, phosphorous, and potassium in a ton of a common grade. Sixteen hundred pounds of blended fertilizer would provide the same amount of plant nutrients normally contained in a ton of the usual 5-20-10.

Bulk blends were competitively priced and cooperatives generally had experienced no major pricing problems with them. However, because liquid nitrogen was frequently cheaper than the dry nitrogen used in the bulk blends, corn growers and some other farmers preferred to apply much of their nitrogen as a liquid side dressing.

Competition

While cooperatives have been pioneers in bulk blending in the area covered in this study, their personnel reported that competition is increasing. They stated that other firms, which generally have resisted bulk blending, are now building plants at a rapid rate.

Competition already is keen in some areas. Two plants contacted reported that six other bulk blenders were operating in the same general territory they were serving. Most plants reported from two to four other plants operating in the same general area, but two plant managers said no other plants were located in their area.

Cooperatives could face a serious problem, if many new blenders attempt to cut price by reducing service. Cooperatives that have based their program on service may, in the future, find themselves providing the farmers with fertilizer services but not with fertilizer. Although price cutting has not been a serious problem, it may become more serious, as the number of plants increases.

Farmers are becoming more knowledgeable about fertilizer use as a result of cooperative educational programs, and thus are becoming more capable of making intelligent purchases from dealers. Cooperatives may need a new approach to their educational and service programs. They cannot assume that farmers who use their services will necessarily purchase fertilizer from them.

Although most of the managers said that from 80 to 90 percent of the farmers who were using their services also were buying fertilizer from them, one plant manager, where competition was severe, said only 50 percent of the farmers to which he provided services bought fertilizer from the plant in 1962-63. Thus, cooperatives may need to make more direct or separate charges for their fertilizer and services, or use a more definite fertilizer purchase agreement when providing the service.

Fertilizer Control Laws

Bulk blending operations are subject to inspection by fertilizer control officials. While the bulk blender is not required to register grades, ratios, or blends, he must be licensed by the State, must report the tonnage of each ingredient sold, and is subject to periodic inspection of the materials blended. One of the cooperatives studied does sell a considerable tonnage of blended fertilizer with a guaranteed analysis. It blends some popular grades such as a 6½-26-26, which must be registered with the State in which it is sold.

In Minnesota, each ingredient in bulk blends must be within 0.5 percent of the amount reported by the blender. If any ingredient is short, the blender must reimburse the farmer for the difference. The blend also must be uniformly mixed.

Fertilizer control officials in Minnesota spent much of the fertilizer blending season inspecting bulk blending operations. Inspectors arrived at the plant unannounced and obtained a sample from a batch that was already in the mixer or on a truck.

Plant managers were unanimous in reporting that fertilizer control inspection, while varing from State to State did not create a problem. They also reported that very few of the blends inspected in the States that required this control feature were below requirements of control laws. Most plant managers reported they liked having the operation under State control because this increased farmer confidence and prohibited some blenders from taking advantage of a situation in which they could give farmers less than they claimed.

Plant operator charging a rotary mixer by opening gate on holding bin.

Attitudes Toward the Bulk Blending Program

The bulk fertilizer blending program reduces the local cooperative's handling costs and provides its patrons with many new services at reasonable costs. This section of the report discusses the cooperatives' and the farmers' reactions to bulk fertilizer blending.

Attitudes of Local Cooperatives

The bulk fertilizer blending program as operated by the two regional cooperatives in this study was very attractive to affiliated local cooperatives. The locals were relieved of much of the fertilizer handling. The locals were not required to maintain inventories and to a large extent were relieved of the fertilizer selling job.

Local patrons place their orders through the local cooperatives, and the cooperatives are responsible for delivering and spreading the fertilizer, if the farmer wants this service. However, the locals receive a fee for providing this service. The blending plant managers provide the soil sampling service, sell the farmer on the use of the program, determine his fertilizer needs, and maintain the inventories.

For these reasons, local cooperatives using the program were generally enthusiastic about it. However, not all local cooperatives eligible to use the program did so. While some plants served more than 15 locals, most of the plant volume went through a few nearby ones. In some cases, half of the plant's volume would go through the local cooperative located in the same town. It appears that some plant managers should give careful attention to means of increasing volume by installing bulk depots in outlying areas.

The amount of business each plant did with a local, however, was not strictly dependent upon distance from the plant. Some nearby locals did not utilize the plant because they did not understand or approve of the service and feared a loss of bagged tonnage, or for various other reasons preferred other fertilizer distribution methods.[1]

Attitudes of Farmers

Farmers' reactions to the bulk blending program apparently have been favorable. Farmers are becoming more informed on fertility and cropping techniques. Through the program, they are increasing their yields and profit, obtaining extra services, and getting quality fertilizer at competitive prices. However, there generally has been no rush of farmers to use the program. Most farmers must be sold on its advantages.

Changes Required of Farmers

Probably the most difficult problem in getting farmers to use the program is that it requires them to make certain changes. Among these are handling fertilizer in bulk, using ratios rather than grades, not using fillers, and using simple mixing equipment.

Comments in this section concerning farmer attitudes are based on reports from plant managers. While the writer does not pass judgment on these attitudes, they are important because successful bulk blenders must be sensitive to the farmers' reactions and adjust their operations accordingly.

Comments based on interviews with plant managers regarding each type of change follow.

Bulk Handling.--Farmers are generally accustomed to using bags. They frequently consider bags easier to handle. They are confident the bag contains what it reports, and they say bags are easily stored. However, most farmers soon discover that bulk handling is easier and that the plant nutrient content is equivalent to what they have been getting in bags.

Grades to Ratios.--Many farmers think they must buy a certain grade. The bulk-fertilizer blend program requires thinking in terms of a ratio, such as 1-2-3 rather than a 4-8-12 grade.

Fewer Pounds of Material.--Farmers frequently have thought in terms of buying tons of fertilizer rather than pounds of plant nutrients. They are not sure that 1,500 pounds of certain bulk blends contain as much plant nutrient as a ton of bagged goods.

Bulk blends provide the same amount of plant nutrients with fewer pounds of material because they use higher analysis ingredients. Bulk blends in the area covered in the study had an average plant food content of nearly 60 percent, compared with 40 to 45 percent for conventional mixed fertilizer in the area.

Simple Mixing Facilities.--Some farmers were apprehensive that fertilizer mixed with simple equipment in their local community was not as good as other fertilizer mixed in large commercial plants. They were concerned about the possibility of chemical reactions and segregation of particles. However, bulk blends have generally proven to be as well mixed as other mixed fertilizers. Once the farmer discovers that his fears are unfounded after using the service, he often becomes a steady customer.

Points Favored by Farmers

The phase farmers liked most about the program was the service associated with it. Before using bulk blending, many farmers never really knew how to buy fertilizer. They were buying a ton of material. Now they are buying pounds of plant nutrients (N-P_2O_5-K_2O) because their soil test indicates a need for a certain number of pounds of each ingredient to produce the crops they intend to grow and to obtain the yields they want.

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[1] Actually while bagged tonnage dropped slightly, total tonnage of the plants increased considerably.

The farmers also liked the spreading service; they did not have to invest their capital in equipment or use their labor in applying the fertilizer. They liked being able to get the exact amount of nutrients they needed without having to pay for fillers. They liked a dealer who they believed would give them a quality product.

General Observations

Based on findings of this study, comments of a general evaluation nature, and suggestions for improving bulk blending services follow.

Evaluation of the Program

Bulk fertilizer blending has been increasing at a rapid rate in the last 5 or 10 years. In 1955, only a few plants were in operation in the United States. Today about 1,000 exist, with more being added each year. Most of the growth to date has been in the Midwest.

Bulk blending accounts for a significant share of the fertilizer market in some sections of the country. In Iowa, bulk blends account for about 20 percent of all fertilizer sales and about 50 percent of the bulk fertilizer sales. However, bulk blending appears to be especially adapted to the concentrated agriculture in the Midwest and probably would not realize the same efficiencies in all other agricultural areas.

Cooperatives have been important in developing bulk blending in the Midwest. They account for over one-third of the blending plants in the area. Cooperatives have been pioneers in developing educational programs and have emphasized the service and soil testing aspects of the program from the start.

These and other factors, such as (1) services offered, (2) low cost, (3) increasing interest in broadcast application, and (4) lack of fertilizer manufacturing facilities in the area, have contributed to the rapid growth of bulk blending in the Midwest.

Problems sometimes cited are:

1. Segregation of particles. While not a problem in mixing, this was sometimes a problem in spreading.

2. Lack of inspection in some States. Farmers are often forced to rely on the integrity of the dealer.

3. Agricultural concentration. Plants must be located in an area where farming with heavy fertilizer use is concentrated.

Studies by TVA indicate that the total cost per unit of plant food for material and mixing is less for dry bulk blends than for any type of liquid mixed fertilizer. However, the cost of salt suspensions or slurries is only slightly greater than the cost of dry bulk blends. If salt suspensions gain farmer acceptability, dry bulk blends may give way to a greater use of liquid mixes.

While bulk blending is increasing at a rapid rate, it is only one of many developments taking place in the fertilizer industry; and it seems unlikely that bulk blending will become the sole method of fertilizer distribution. Factors which will tend to limit the growth of bulk blending are (1) the limited geographic adaptability; (2) improvements being made in liquid mixes; and (3) the use of three-hopper trucks which can make broadcast applications of individual plant nutrients.

Cooperatives will need to evaluate these and other developments in the fertilizer industry before considering the addition of a bulk blending service. They may wish to offer bulk handling of common grades, or liquid and bag service along with bulk blending. However, the benefits of the program in many areas, especially in the upper Midwest, appear to assure that bulk blending will continue to attract more farmers in the immediate future.

Suggestions for Improvement

Education.--Continue to educate farmers, emphasizing the service and economic aspects of the program. Contacts with farmers through their local cooperatives are essential to obtain a desirable volume.

Service.--Offer a complete fertilizer service. Charge for services, if necessary, or tie service to purchase of fertilizer.

Inspection.--Offer a quality product and service to obtain farmer confidence, if adequate inspection is not available.

Volume.--Maximize plant tonnage to keep unit costs at a minimum.

Delivery and Spreading.--Obtain most efficient use of delivery and spreading equipment by using nurse trucks and tote boxes and having cooperative personnel operate this equipment whenever possible. Arrange with other dealers for sharing delivery and spreading equipment in peak seasons.

Seasonality.--Even out sales peaks by offering fall discounts and by conducting educational programs among farmers.

Management.--Employ technically capable men with outstanding promotional ability.

Plant Assistants.--Consider having a year-round employee to assure capable help when needed to assist in soil sampling, educational work, and plant maintenance.

Buildings.--Make certain wall construction is sufficiently rigid to prevent buckling because of the weight of ingredient materials.

Appendix

Map of Farm

Sketch in fields and buildings of your farm. Indicate on this map where soil samples have been taken.

History of Soil Tests

Field	Year of Soil Test	Soil Test Results				
		Nitrogen	Phosphorus	Potash	p^H	
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						
L						
M						
N						
O						

Farm Crop Rotation Plan

Field & Description		19___	19___	19___	19___	19___
A						
B						
C						
D						
E						
F						

Fertilization Record

Field	Year of Soil Test	Fertilizer & Lime Recommendations	Actual Fertilizer Applied
A			
B			
C			
D			
E			
F			

5-Year Yield Record

Field	Crop	19___	19___	19___	19___	19___
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
K						
L						
M						

Crop Income and Expense Record

Year ____________

Field	Expense Items		Total Amt. of Purchase	Crop ______	Crop ______	Crop ______	Crop ______	Crop ______	Crop ______	Yearly Totals
	Description	Quantity								
	TOTAL EXPENSES:									
	GROSS INCOME:									
	LESS TOTAL EXPENSE:									
	NET INCOME:									

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Other FCS Publications Available

Bulk Distribution of Fertilizer and Lime in the Northeast, General Report 24. Warren K. Trotter.

Liquid Fertilizer Distribution by Local Cooperatives in the Pacific Northwest, General Report 95. B. H. Pentecost.

Manufacture of Fertilizer by Cooperatives in the South, FCS Bulletin 13. Warren K. Trotter.

Distribution of Fertilizer by Cooperatives in the South, FCS Bulletin 11. Warren K. Trotter.

Fertilizer Distribution: Methods and Costs, Service Report 19. M. A. Abrahamsen.

Methods of Financing Farmer Cooperatives, General Report 32. H. H. Hulbert, Nelda Griffin, and K. B. Gardner.

Statistics of Farmer Cooperatives, 1961-62, General Report 119. Anne L. Gessner.

Lawn and Garden Services in Eastern Farmer Co-ops, General Report 107. John M. Bailey.

Regional Cooperatives Handling Under $10 Million of Supplies, 1960-61, General Report 115. J. Warren Mather and Anne L. Gessner.

Broiler and Turkey Feed Financing by Cooperatives, General Report 118. George C. Allen.

A copy of each of these publications may be obtained while a supply is available from--

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